

TITLE OF THE INVENTION

Automatic Stainer Having a Heating Station

CROSS-REFERENCE TO RELATED APPLICATIONS

- 5 [0001] This application claims priority of a German patent application DE 100 06 084.6 filed February 11, 2000 which is incorporated by reference herein.

FIELD OF THE INVENTION

- 10 [0002] The invention concerns an automatic stainer for staining specimens that are arranged on specimen slides and embedded in a medium, preferably in paraffin, in which multiple reagent containers arranged one behind another are provided for treating the specimens, and the specimen slides pass successively through the reagent containers; having a transport basket for receiving multiple specimen slides, such that multiple transport baskets can be received simultaneously each in different reagent containers; and
- 15 having a motorized transport mechanism with a lifting device that lifts all the transport baskets simultaneously out of the respective reagent container and transports them on into the respective adjacent reagent container.

BACKGROUND OF THE INVENTION

- 20 [0003] The histological specimens provided for microscopic examination are placed onto specimen slides after being cut with a microtome. The specimen slide is then appropriately labeled and cataloged. To increase contrast for a subsequent microscopic examination, these specimens are then stained, making the structures in the cells or the tissues visible in differentiated fashion. In addition to various special stains, one standard
- 25 staining process has become established in practical use. In this "hematoxylin-eosin" staining method, the specimens pass through different processing stages with xylene, alcohol, eosin, hematoxylin, acetic acid, and water. Various types of automatic stainers, which automatically convey the specimens to the respective processing stages, are used to stain the specimens.
- 30 [0004] Automatic stainers with a simplified transport mechanism and a high preparation throughput are offered by the company styled "medite" under the designation

"COT 20," and by the company styled "Sakura" under the designation "Linear Slide Stainer II." Both automatic stainers operate on the principle of a continuously recirculating transport motion for the transport baskets in which the specimen slides with the specimens are located. During the transport motion, the transport baskets are transported, at constant cycling times, into the reagent containers arranged one behind another. Any necessary residence time for the specimens in the respective containers is achieved using multiple reagent containers arranged one behind another. The transport basket is suspended in a transport rail, and conveyed by the transport rail a specific distance to the next reagent container where it is lowered again. The transport rail travels beneath the support bracket of the transport basket back into its starting position. Another transport basket can now be placed onto the transport rail. Once a predefined time interval has elapsed, the transport rail simultaneously lifts up all the transport baskets present in the automatic stainer, and transports them into the next reagent containers.

[0005] Before the specimens (usually embedded in paraffin) can be subjected to treatment in an automatic stainer of this kind, the embedding medium (in this case paraffin) must be gently removed. Otherwise the risk exists that the staining solutions will not be able to penetrate into the tissue. For this reason, before treatment the specimen slides are heated in a separate oven until the paraffin present on the specimen slides has vaporized or melted.

[0006] The separate oven makes an additional manual process step necessary in this case. The risk also exists, when the heated specimen slides are being handled, that the operator may be burned and that hot specimen slides may be dropped upon removal.

BRIEF SUMMARY OF THE INVENTION

[0007] It is therefore the object of the present invention to further develop a known automatic stainer in such a way that no additional manual working steps are necessary in order to remove the embedding medium prior to staining of the specimen.

[0008] This object is achieved, according to the present invention, by the features recited in the characterizing portion of Claim 1. Further advantageous developments are the subject matter of the dependent claims.

[0009] The automatic stainer is characterized in that a heating station for heating the specimens and melting the embedding medium is arranged in front of the row of reagent containers and is integrated into the transport mechanism, and the heating station has at least one melting container for simultaneously receiving multiple transport baskets.

5 [0010] In an embodiment of the invention, the heating station has an oven housing which is equipped with a fan and an electric heating package. Instead of a fan, it is of course also possible to provide a fluid which is heated by the heating package.

[0011] An air distributor, which directs the heated air via an opening in the wall or the floor of the melting container onto the specimen slides, can be provided in the oven
10 housing.

[0012] In a further embodiment of the invention, the temperature inside the heating station can be adjusted by way of a controller. If multiple melting containers arranged next to one another are present in the heating station, the temperature in each melting container can be adjusted separately by way of the controller.

15 [0013] The lifting device can be equipped with two transport rails, arranged parallel to one another, which are each equipped with a transport notch in the region of the reagent containers, and with a sawtooth profile in the region of the heating station. As a result, in the region of the reagent containers the transport baskets are transported on into the respective adjacent reagent container with one transport stroke, the transport baskets
20 simultaneously traveling a shorter distance in the region of the heating station. The sawtooth profile is configured in such a way that the brackets of the transport baskets, when lifted, slide down on the flanks of the profile and are entrained only by the shoulder.

[0014] In an embodiment of the invention, two support rails equipped with grooves
25 are arranged in the region of the heating station, parallel to the transport rails, as a support for the brackets of the transport baskets.

[0015] The spacing between adjacent grooves can be half as great as the spacing between the individual reagent containers arranged one behind another.

[0016] In the case of the sawtooth profile, the slope of the flanks and their spacing
30 from one another can be such that in the region of the heating station, each transport basket is conveyed into the adjacent groove with one transport stroke.

5 **[0018]** The invention will be explained in more detail with reference to an exemplary embodiment, with the aid of the schematic drawings, in which:

FIG. 1 shows a view of a transport basket with specimen slides;

FIG. 2 shows a view of the automatic stainer with the heating station attached;

FIG. 3 shows a view of the oven housing with heating package.

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[0019] FIG. 1 shows a transport basket 4 with four specimen slides 2 in place, as ordinarily used for transport in the automatic stainer described below. Mounted detachably on transport basket 4 is a transport bracket 21 with which transport basket 4 is suspended in the transport mechanism of the automatic stainer. Transport basket 4 and the transport bracket are in this case, advantageously, made of stainless steel.

30 **[0021]** In the region of reagent containers 3, baskets 4 are transported on, in the context of the transport motion, into containers 3 arranged one behind another. In that

context, transport basket 4 is lifted completely out of reagent container 3 by way of transport notches 17 in transport rail 16 of lifting device 7, then transported horizontally to the next reagent container 3 and there lowered again. Transport rail 16 is lowered by lifting device 7 until transport bracket 16 leaves transport notches 17 and is supported on the frame of reagent container 3 or the frame of automatic stainer 1. Lifting device 7 is now disengaged, and travels back, beneath transport bracket 21 of transport basket 4, into its starting position. After a predefined cycle time has elapsed, lifting device 7 simultaneously lifts all transport baskets 4 and transports them into the next reagent container 3.

10 [0022] Baskets 4 are transported in equivalent fashion in the region of heating station 8. Here, however, the transport notches in transport rails 16 are configured as a sawtooth profile 18. Brackets 21 of transport baskets 4 therefore slide down on the flanks of sawtooth profile 18 when transport rails 16 are lifted, and are entrained only by the shoulders on sawtooth profile 18. Brackets 21 of transport baskets 4 are then set down
15 into the next groove 20 of support rail 19. The slope of the flanks of sawtooth profile 18 is such that with each transport step, transport basket 4 travels approximately half the distance traveled by transport basket 4 in the region of reagent containers 3. The spacing of grooves 20 present in support rails 19 is also adapted to this shorter distance. The result is that in the region of heating station 8, transport baskets follow one another more
20 closely and the space required for transport baskets 4 is thus minimized.

[0023] Heating station 8 has an oven housing 10 having a fan 22 and an electrically operating heating package 23 (FIG. 3). Air is drawn in from below by fan 22 and heated by heating package 23. The heated air is then directed from below, via an air distributor 13, into melting containers 9. For that purpose, several openings 14 in the walls and/or
25 floor of melting containers 9 are associated with air distributor 13. The air emerging from the top of melting containers 9 is drawn into a fan housing 12 by a fan, and conveyed via a connector tube 11 to an air discharge system (not depicted). It has proven to be advantageous to draw off the hot air in this fashion, since otherwise the entire unit, along with the reagent containers, would heat up. The volatile reagents, for example
30 xylene or alcohol, would evaporate without being used.

[0024] Heating station 8 is equipped with a controller 15 in order to adjust the temperature. If multiple melting containers 9 are used in heating station 8, the temperature in each container 9 can be adjusted separately and independently by way of controller 15. Heating package 23 of the heating station can be switched on and off using main switch 6.

[0025] Specimen slides 2 with the specimen embedded in paraffin are heated by the hot air. The paraffin melts and partially vaporizes from specimen slides 2. At the end of melting container 9, specimen slide 2 with the specimen has been heated so that any remaining paraffin still present can very easily be dissolved away. This is accomplished by the fact that transport basket 4 is lifted by lifting device 7 into the first reagent container 3. The first reagent container 3 is usually filled with xylene, a very good solvent for paraffin.

[0026] The heating station can be configured as a retrofittable module, and adapted to the various automatic stainers. All that is necessary for that purpose is an adapter which extends the transport rails of the automatic stainer and has a corresponding sawtooth profile. The heating station can of course be used not only for specimens embedded in paraffin, but also in cases where the preparation is embedded, for example, in a suitable medium such as plastic.

[0027] FIG. 3 shows a schematic depiction of oven housing 10 with fan 22 and heating package 23. Air is drawn in by fan 22, heated by heating package 23, and delivered through openings 14 to melting containers 9.

[0028] In this exemplary embodiment, the heating station is described as a hot-air heating system. It is understood that this heating system can also be implemented with a water bath or a bath having a suitable fluid.

PARTS LIST

1	Automatic stainer
2	Specimen slide
3	Reagent container
30 4	Transport basket
5	Control panel

	6	Main switch
	7	Lifting device
	8	Heating station
	9	Melting container
5	10	Oven housing
	11	Connector tube
	12	Fan housing
	13	Air distributor
	14	Openings
10	15	Controller
	16	Transport rails
	17	Transport notches
	18	Sawtooth profile
	19	Support rails
15	20	Grooves in 19
	21	Transport brackets
	22	Fan
	23	Heating package

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